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JAPANESE

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## PATENT ABSTRACTS OF JAPAN

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(71)Applicant : SENOH CORP

(22)Date of filing : 11.09.1997

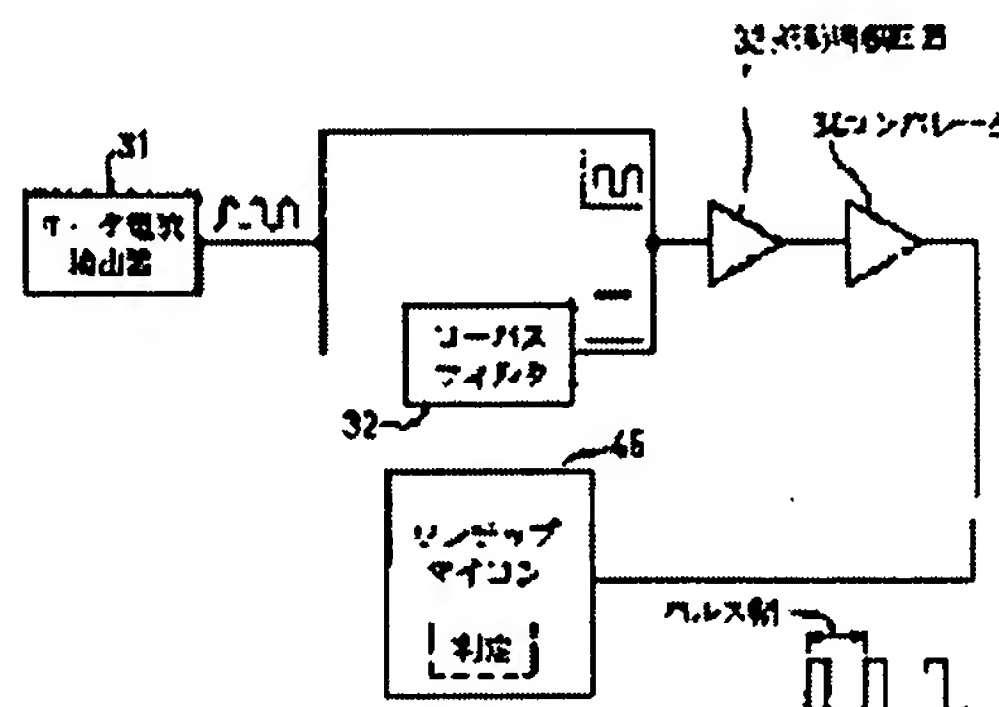
(72)Inventor : MURAKAMI YASUYUKI

## (54) STRIDE AND NUMBER-OF-STEPS DETECTING DEVICE AND SAFETY DEVICE FOR RUNNING MACHINE

## (57)Abstract:

PROBLEM TO BE SOLVED: To monitor turbulence of a stride, and perform emergency stop (slow stop), warning and display so as to ensure safety in a running machine which includes a traveling belt turned by an electric motor, and in which a user runs or walks on the traveling belt.

SOLUTION: An electric current flowing through an electric motor is detected by a motor current detector 31. The detected current of the detector 31 is converted to a pulse signal by a low-pass filter 32, a differential amplifying circuit 33 and a comparator 34, and the signal is input to a microcomputer. In the microcomputer 45, the proportion of the width of an output pulse signal of a comparator to the stride is utilized to compare the average value of pulse widths with the width of a pulse signal, and when a deviation is a designated value or more, turbulence is caused in the stride, and abnormality is decided. In the case where turbulence of stride is detected, according to the decision output of the microcomputer 45, the traveling belt is immediately stopped (slow stop). Thus, safety of a user can be ensured.



## LEGAL STATUS

[Date of request for examination]

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TECHNICAL FIELD

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[The technical field to which invention belongs] the step of a running machine which can make safety suspend equipment while this invention is equipped with the endless transit belt which rotates with an electric motor, and relates to the running machine (treadmill) by which the transit or the walk by the user is performed on said transit belt, especially detecting a step and the number of steps when turbulence is in a step, and the number of steps -- it is related with detection equipment and a safety device.

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PRIOR ART

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[Description of the Prior Art] A running machine is equipment which performs transit or a walk on the endless transit belt which rotates with an electric motor, and running of the flat ground, Walking Magazine, and a slope run up it, and it is used for practice and the object for rehabilitation of movement etc. Furthermore, it is used also as load inspection equipment for medical checkups, such as oxygen consumption measurement, a cardiac pulmonary function test, and various stress analyses.

[0003] Drawing 4 - drawing 6 show an example of the running machine which adopted the general belt method, and drawing 4 is operation explanatory drawing in which a side elevation and drawing 5 show a plan, and drawing 6 shows the situation of accommodation whenever [ tilt-angle ]. In these drawings, 1 is the main part frame of an abbreviation rectangle, the handrail section 2 which becomes the anterior part right-and-left both sides of this main part frame 1 from the pipe of an abbreviation U typeface is set up, and the foot rest 3 of an abbreviation U typeface is connected as well as posterior part right-and-left both sides, and it is constituted so that the main part frame 1 can be held in predetermined height from a floor line F.

[0004] A mechanical component 4 is formed ahead of said handrail section 2, and the endless transit belt 5 which rotates by this mechanical component 4 is hung about on the drums 6a and 6b (drum 6a of the front end section is an illustration abbreviation) supported to revolve by the main part frame 1 order edge rotatable. 7 is the liner material (supporting plate) arranged in the inferior surface of tongue of the transit belt 5 of the side to which transit and a walk are performed.

[0005] Drum 6a of said front end section is carried in the anterior part frame 9 which engages with the shaft 8 bearing of the rotation of is made free, and said mechanical component 4 is covered with covering 10. The motor control machine which consists of the 2nd motor for adjusting whenever [ tilt-angle / of the 1st motor which is made to rotate said drum 6a and is made to rotate the transit belt 5, and the main part frame 1 ], an inverter, etc. is arranged in the interior of this covering 10.

[0006] 11 is the rod prepared in the base side of the main part frame 1, and the end is connected with the rod 12 which extends in the back end section of the main part frame 1, and is supported pivotable between the foot rests 3 by T typeface, and constitutes the connection lever in which a flexible drive is possible. The other end of a rod 11 is connected with the end of a tube 13 rockable, and the nut (illustration abbreviation) is being fixed to the other end of this tube 13. The edge of a shaft 14 rotated by the 2nd motor for accommodation whenever [ said tilt-angle ] is screwing in this nut as a screw shaft. In addition, 15 is the koro prepared in the edge side of the anterior part frame 9 pivotable.

[0007] A shaft 14 will frequent a tube 13, and if said shaft 14 is rotated by said 2nd motor by such configuration, as the anterior part frame 9 rises and falls as a center and shows a shaft 8 to drawing 6, by it, the main part frame 1 and the anterior part frame 9 will go up and down from a floor line F focusing on a shaft 8. Whenever [ tilt-angle / of the main part frame 1 ] can be changed free by this.

[0008] Moreover, a control panel 16 is formed in the topmost part of the handrail section 2, and the electric display 18 for checking the manual operation button 17 and said control command for emitting the control command of whenever [ speed or tilt-angle ] on said motor etc. is formed in this control panel 16.

[0009] The electrical circuit of the above running machines is constituted like drawing 7 . The end of the power supply breaker 22 is connected to the plug 21 in drawing 7 . The inverter 23, the interface-circuitry substrate 24, and alternating voltage by which the other end of the power supply breaker 22 controls the 1st motor made to rotate said transit belt 5 are respectively connected to the switching power supply 25 which changes into a direct current of +5V and is supplied to said interface-circuitry substrate 24.

[0010] Said inverter 23 consists of a rectification circuit which carries out conversion into dc of the alternating current power inputted through the power supply breaker 22, a direct-current intermediate circuit which carries out smooth [ of the output of this rectification circuit ], and an inverse transformation circuit which changes into desired alternating current power the direct current power of this direct-current intermediate circuit by which smooth was carried out.

[0011] The inverter drive of this inverse transformation circuit is carried out by supplying the control current according to the speed command from the control circuit substrate (microcomputer) 26 connected to said interface circuitry 24 to the controlling element by which three-phase bridge rectifier connection was carried out, for example, a transistor, through a signal line 27.

[0012] 28 is driven by the alternating current output power of said inverter 23, is the 1st motor made to rotate said transit belt 5, for example, consists of induction motors of three phase 200V.

[0013] It connects with said interface-circuitry substrate 24, and 29 is a motor for adjusting whenever [ tilt-angle / of said frame 1 ], for example, consists of induction motors of single phase 100V.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] the step of a running machine which can make safety suspend equipment while this invention is equipped with the endless transit belt which rotates with an electric motor, and relates to the running machine (treadmill) by which the transit or the walk by the user is performed on said transit belt, especially detecting a step and the number of steps when turbulence is in a step, and the number of steps -- it is related with detection equipment and a safety device.

[0002]

[Description of the Prior Art] A running machine is equipment which performs transit or a walk on the endless transit belt which rotates with an electric motor, and running of the flat ground, Walking Magazine, and a slope run up it, and it is used for practice and the object for rehabilitation of movement etc. Furthermore, it is used also as load inspection equipment for medical checkups, such as oxygen consumption measurement, a cardiac pulmonary function test, and various stress analyses.

[0003] Drawing 4 - drawing 6 show an example of the running machine which adopted the general belt method, and drawing 4 is operation explanatory drawing in which a side elevation and drawing 5 show a plan, and drawing 6 shows the situation of accommodation whenever [ tilt-angle ]. In these drawings, 1 is the main part frame of an abbreviation rectangle, the handrail section 2 which becomes the anterior part right-and-left both sides of this main part frame 1 from the pipe of an abbreviation U typeface is set up, and the foot rest 3 of an abbreviation U typeface is connected as well as posterior part right-and-left both sides, and it is constituted so that the main part frame 1 can be held in predetermined height from a floor line F.

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[0008] Moreover, a control panel 16 is formed in the topmost part of the handrail section 2, and the electric display 18 for checking the manual operation button 17 and said control command for emitting the control command of whenever [ speed or tilt-angle ] on said motor etc. is formed in this control panel 16.

[0009] The electrical circuit of the above running machines is constituted like drawing 7. The end of the power supply breaker 22 is connected to the plug 21 in drawing 7. The inverter 23, the interface-circuitry substrate 24, and alternating voltage by which the other end of the power supply breaker 22 controls the 1st motor made to rotate said transit belt 5 are respectively connected to the switching power supply 25 which changes into a direct current of +5V and is supplied to said interface-circuitry substrate 24.

[0010] Said inverter 23 consists of a rectification circuit which carries out conversion into dc of the alternating current power inputted through the power supply breaker 22, a direct-current intermediate circuit which carries out smooth [ of the output of this rectification circuit ], and an inverse transformation circuit which changes into desired alternating current power the direct current power of this direct-current intermediate circuit by which smooth was carried out.

[0011]

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MEANS

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[Means for Solving the Problem]

(1) In a running machine by which this invention is equipped with an endless transit belt which rotates with an electric motor, and a user performs transit or a walk on this transit belt A current detecting element which detects current which flows to said electric motor, and the signal transformation section which changes detection current of said current detecting element into a pulse signal, a step which asks for a user's step and the number of steps based on a pulse signal changed in said signal transformation section, and the number of steps -- having had operation part -- the feature -- carrying out -- said step and the number of steps -- operation part consisting of operation part which asks for a step by measuring width of face of said pulse signal, and carrying out the multiplication of the travel speed of a running machine to this measurement value -- the feature -- carrying out -- said step and the number of steps -- operation part is characterized by having a called-for step and a function which displays the number of steps.

[0020] Moreover, this invention is equipped with an endless transit belt which rotates with an electric motor, and sets it in a running machine by which a user performs transit or a walk on this transit belt. A current detecting element which detects current which flows to said electric motor, and the signal transformation section which changes detection current of said current detecting element into a pulse signal, It is characterized by having the abnormality judging section which judges whether turbulence is in a user's step based on a pulse signal changed in said signal transformation section. Said abnormality judging section When calculated the average of width of face of said pulse signal, and it asked for deflection of this average and width of face of said pulse signal, it is characterized by judging with those of a step with turbulence when this deflection is beyond a predetermined value, and said abnormality judging section judges with those of a step with turbulence It is characterized by having a function to carry out the slow stop of the transit belt, and when it judges with those of a step with turbulence, said abnormality judging section is characterized by having a function to perform an abnormality display while it emits warning.

[0021] (2) In invention according to claim 1 to 3, when weight is applied on a transit belt by transit or walk while using a running machine, current which flows to an electric motor increases (when it lands on a transit belt). A gap of a mountain of a current wave form at this time and the next mountain is proportional to a step. For this reason, a user's step will be obtained if a travel speed of a running machine is multiplied by width of face of a pulse which carried out signal transformation of the current of an electric motor. Moreover, the number of steps is obtained by carrying out counting of the pulse number. Said step and number of steps which were called for can be used as data for tests of physical strength and fitness. Moreover, by displaying a step and the number of steps, it can judge whether a user is running and walking with a step suitable for the self physique.

[0022] (3) In invention according to claim 4 to 7, when weight is applied on a transit belt by transit or walk while using a running machine, current which flows to an electric motor increases (when it lands on a transit belt). A gap (namely, width of face of a pulse which carried out signal transformation of the current of an electric motor) of a mountain of a current wave form at this time and the next mountain is



proportional to a step. Then, when deflection of the average of width of face of this pulse signal and width of face of a pulse signal is beyond a predetermined value, it can judge with turbulence being in a step. Thus, when turbulence is in a step, it is shown that it became impossible for a user to follow aim speed (travel speed of a belt), and safety is secured by performing a slow stop, warning, an abnormality display, etc.

[0023]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. the step of the running machine of this invention by which drawing 1 was indicated by claims 1-3, and the number of steps -- it is the block diagram showing the gestalt of operation of detection equipment. In drawing 1, 31 is a motor current detector which detects the current which flows to the electric motor for the transit belt driving of a running machine, for example, inserts a current transformer (CT) in the cable run which ties the inverter 23 and the 1st motor 28 of drawing 7, and is constituted.

[0024] 32 is a low pass filter which passes only a dc component from the detection current of the motor current detector 31. 33 is a differential amplifying circuit which amplifies the deflection of the detection current of the motor current detector 31, and the output current of a low pass filter 32, and has cut an in one direction flowed part in said motor current detecting signal.

[0025] The output signal of a differential amplifying circuit 33 is fabricated by the signal of pulse shape like illustration with a comparator 34. This pulse signal is inputted into a microcomputer (one chip microcomputer) 35 as motor current detection data.

[0026] the step which asks for a user's step and the number of steps based on the pulse signal which this microcomputer 35 consists of control circuit substrates 26 of drawing 7, and was inputted from the comparator 34, and the number of steps -- it has the calculation function. The pulse width (time amount) of the output pulse signal of a comparator 34 is specifically counted, the travel speed of a running machine is multiplied by the value, and it asks for a step.

Pulse width x running machine speed = a step and a microcomputer 35 count the pulse number of said pulse signal, and make it the number of steps.

Pulse number = number of steps.

[0027] If here explains the relation between the motor current in a running machine, and a step, while using a running machine, when weight is applied on a transit belt by transit or walk, the current which flows to an electric motor will increase (when it lands on a transit belt). The gap of the mountain of the current wave form at this time and the next mountain is proportional to a step. For this reason, a user's step is obtained by multiplying the travel speed of a running machine by the width of face of the output pulse of the comparator 34 which carried out signal transformation of the current of an electric motor. Moreover, the number of steps is equal to a pulse number.

[0028] The step and the number of steps which were called for with the microcomputer 35 as mentioned above are displayed on the control-panel 16 grade of drawing 4, or are memorized in memory (illustration abbreviation) etc. It can judge whether it is running and walking by this with the step to which it used as data for tests of physical strength and fitness, and the user was suitable for the self physique.

[0029] Next, the gestalt of operation of the safety device of the running machine of this invention indicated by claims 4-7 is explained. In drawing 2, the same portion as drawing 1 is shown with the same sign, and the explanation is omitted. In drawing 2, the motor current detector 31, the low pass filter 32, the differential amplifying circuit 33, and the comparator 34 are constituted identically to drawing 1. A microcomputer (one chip microcomputer) 45 consists of control circuit substrates 26 of drawing 7, and has the abnormality judging function to judge whether turbulence is in a user's step, based on the pulse signal inputted from the comparator 34.

[0030] Specifically the pulse width (time amount) of the output pulse signal of a comparator 34 is counted, the moving average of this pulse width is carried out, and the variation in pulse width is detected. That is, since the width of face of the output pulse signal of a comparator 34 is proportional to a step as explained in drawing 1, the average of this pulse width is compared with the width of face of a



pulse signal, beyond a predetermined value, at a certain time, turbulence has arisen with the step and the deflection judges with those with abnormalities. For example, in the output pulse signal of the comparator 34 shown in drawing 3 , it judges with turbulence having arisen with the step because pulse width changes a lot as b is unusual if pulse width a is the average, and a is unusual, if pulse width b is the average.

[0031] Thus, since it is shown that it became impossible for a user to follow a belt travel speed by poor health etc. when it is detected that turbulence and variation are in a step and it is judged with those with abnormalities, the slow stop of the transit belt is carried out with the decision output of a microcomputer 45. A user's safety is secured by this.

[0032] Moreover, when it judges with turbulence and variation being in a step, warning may be emitted, or you may constitute so that an abnormality display may be performed on a lamp or a display. If turbulence of a step and the existence of variation are furthermore memorized in memory (illustration abbreviation), it can also consider as the decision material of whether to run and walk with the fixed step.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] The running machine constituted as mentioned above can set up various practice programs in the flat ground, an inclined plane, Walking Magazine, or running. Moreover, it has the function which indicates a condition in use, for example, elapsed time, mileage, average speed, the consumption calorie, etc. by the display.

[0015] However, there was no thing equipped with the function which measures and displays the step under transit and walk and the number of steps in the conventional running machine. Although it is the favorable factor which judges whether measuring said step and the number of steps is exercising with the step to which the user was suitable for the self physique, the measuring method is troublesome and it is expected that an equipment configuration becomes complicated.

[0016] Moreover, emergency shut down switch 30a or 30b shown in drawing 8 is prepared while in use at the running machine the sake [ when you want to stop movement by poor health etc. ]. 30a is the push button-type emergency shut down switch prepared in the handrail section, and 30b is an emergency shut down switch of the so-called string type with which some a user's bodies are made to stop a string's tip connected to the pull switch by the side of a control panel, and a user lengthens the string.

[0017] However, when the above emergency shut down switch 30a or 30b must be operated, since the user itself does not have remaining power, actuation of a switch may be overdue. In such a condition, it is irregular to a user's transit and a walk, and turbulence arises with a step. For this reason, if a step can be supervised while using this running machine, \*\*\*\* is enabled to detect [ to burn ] the condition that it became impossible for a user to follow the travel speed of a transit belt, and suitable treatment, such as carrying out the slow stop of the equipment automatically, can be performed.

[0018] This invention is what was made in view of the above-mentioned point. The purpose While being able to detect and display the step and the number of steps which are an item important as a decision material of a movement condition by the easy equipment configuration supervising turbulence of a step - a user's poor health etc. -- detecting -- an emergency shut down (slow stop) -- or the step of a running machine which can perform warning and a display and can secure a user's safety and the number of steps -- it is in offering detection equipment and a safety device.

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EFFECT OF THE INVENTION

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[Effect of the Invention]

(1) According to invention according to claim 1 to 3, it can ask for a running machine user's step, and the number of steps by the easy equipment configuration as mentioned above. For this reason, the step and the number of steps which were detected can be displayed, or it can use as data for tests of physical strength and fitness, and can judge whether it is running and walking with the step to which the user was suitable for the self physique.

[0034] (2) Moreover, according to invention according to claim 4 to 7, turbulence of a running machine user's step can be supervised by the easy equipment configuration. For this reason, a user's poor health etc. can be detected, an emergency shut down (slow stop), and warning or a display can be performed, and a user's safety can be secured. Moreover, turbulence of a step can be checked and it can also use as data for tests of physical strength and fitness.

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CLAIMS

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[Claim(s)]

[Claim 1] A running machine by which it has an endless transit belt which is characterized by providing the following, and which rotates with an electric motor, and a user performs transit or a walk on this transit belt A current detecting element which detects current which flows to said electric motor The signal transformation section which changes detection current of said current detecting element into a pulse signal a step which asks for a user's step and the number of steps based on a pulse signal changed in said signal transformation section, and the number of steps -- operation part

[Claim 2] said step and the number of steps -- a step of a running machine according to claim 1 characterized by operation part consisting of operation part which asks for a step by measuring width of face of said pulse signal, and carrying out the multiplication of the travel speed of a running machine to this measurement value, and the number of steps -- detection equipment.

[Claim 3] said step and the number of steps -- a step of a running machine according to claim 1 or 2 characterized by operation part having a called-for step and a function which displays the number of steps, and the number of steps -- detection equipment.

[Claim 4] A running machine by which it has an endless transit belt which is characterized by providing the following, and which rotates with an electric motor, and a user performs transit or a walk on this transit belt A current detecting element which detects current which flows to said electric motor The signal transformation section which changes detection current of said current detecting element into a pulse signal The abnormality judging section which judges whether turbulence is in a user's step based on a pulse signal changed in said signal transformation section

[Claim 5] Said abnormality judging section is the safety device of a running machine according to claim 4 characterized by calculating the average of width of face of said pulse signal, asking for deflection of this average and width of face of said pulse signal, and judging with those of a step with turbulence when this deflection is beyond a predetermined value.

[Claim 6] Said abnormality judging section is the safety device of a running machine according to claim 4 or 5 characterized by having a function to carry out the slow stop of the transit belt when it judges with those of a step with turbulence.

[Claim 7] Said abnormality judging section is the safety device of a running machine according to claim 4, 5, or 6 characterized by having a function to perform an abnormality display while emitting warning when it judges with those of a step with turbulence.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The block diagram showing the example of 1 operation gestalt of this invention.

[Drawing 2] The block diagram showing other examples of an operation gestalt of this invention.

[Drawing 3] The current wave form Fig. showing the wave which changed the motor current detecting signal into the pulse signal.

[Drawing 4] The side elevation of the conventional running machine.

[Drawing 5] The plan of the conventional running machine.

[Drawing 6] Operation explanatory drawing showing the situation of accommodation whenever [ tilt-angle / of the conventional running machine ].

[Drawing 7] The block diagram of the electrical circuit of the conventional running machine.

[Drawing 8] The perspective diagram showing the important section of the conventional running machine.

[Description of Notations]

4 -- Mechanical component

5 -- Transit belt

16 -- Control panel

23 -- Inverter

24 -- Interface-circuitry substrate

26 -- Control circuit substrate

28 -- The 1st motor

29 -- The 2nd motor

30a, 30b -- Emergency shut down switch

31 -- Motor current detector

32 -- Low pass filter

33 -- Differential amplifying circuit

34 -- Comparator

35 45 -- Microcomputer

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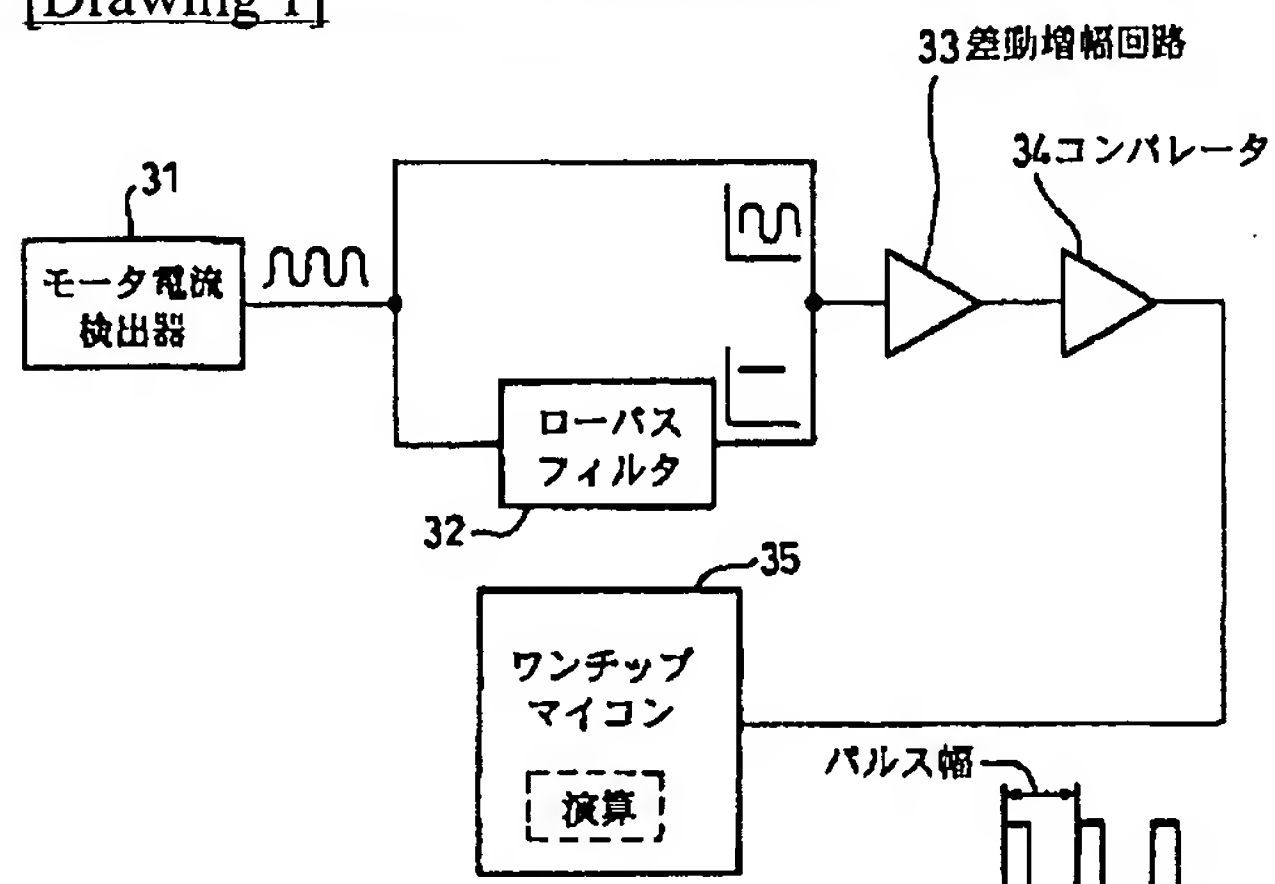
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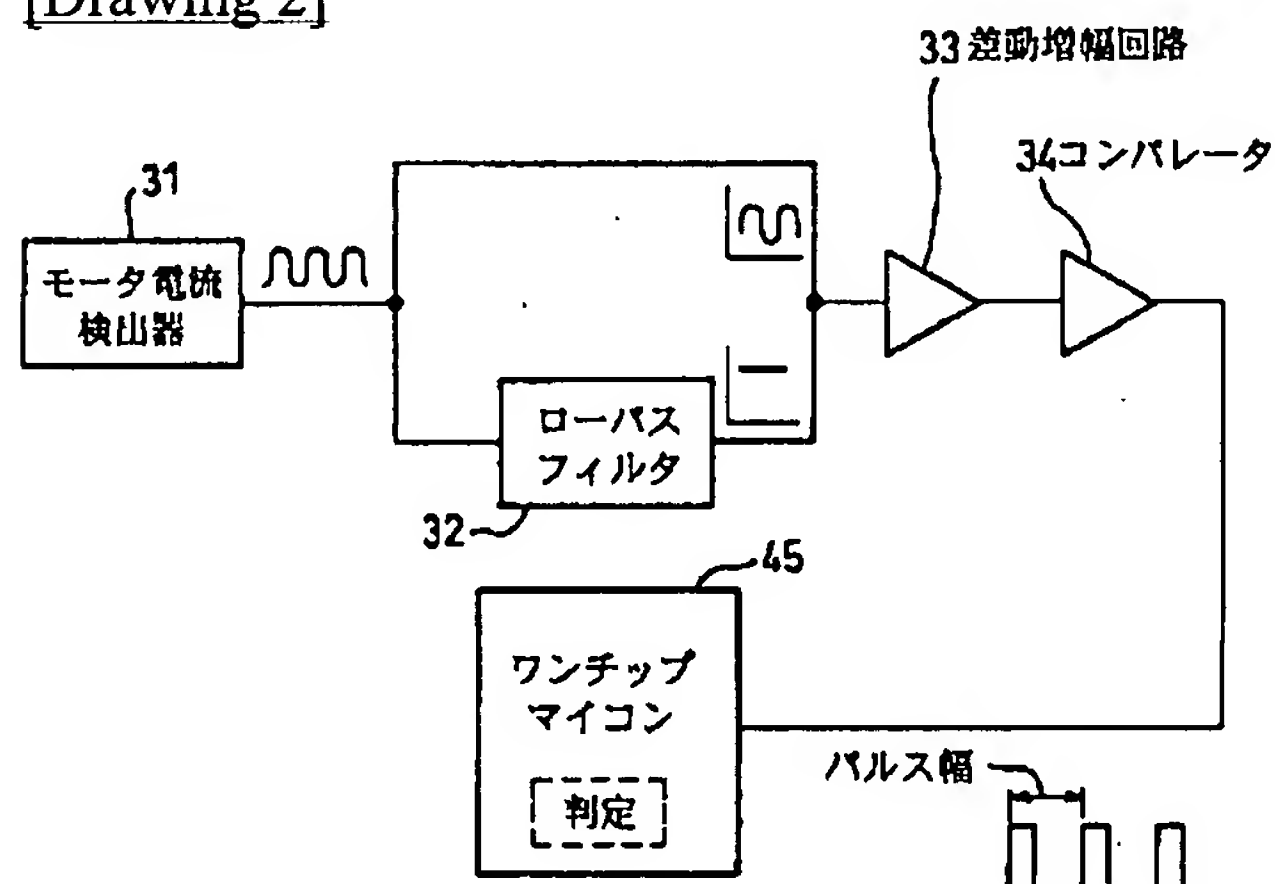
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## DRAWINGS

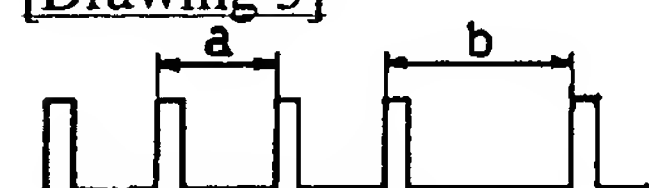
[Drawing 1]



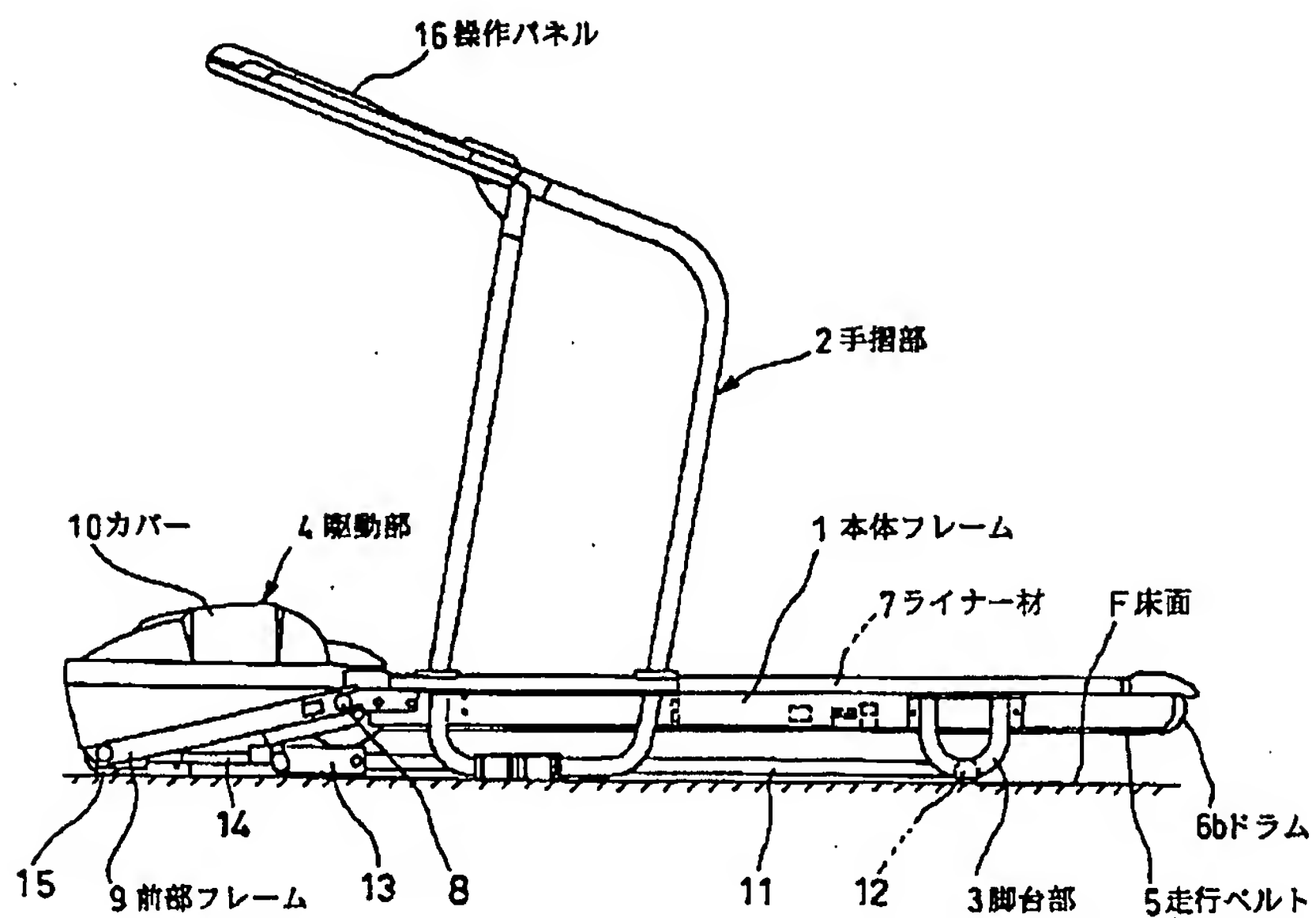
[Drawing 2]



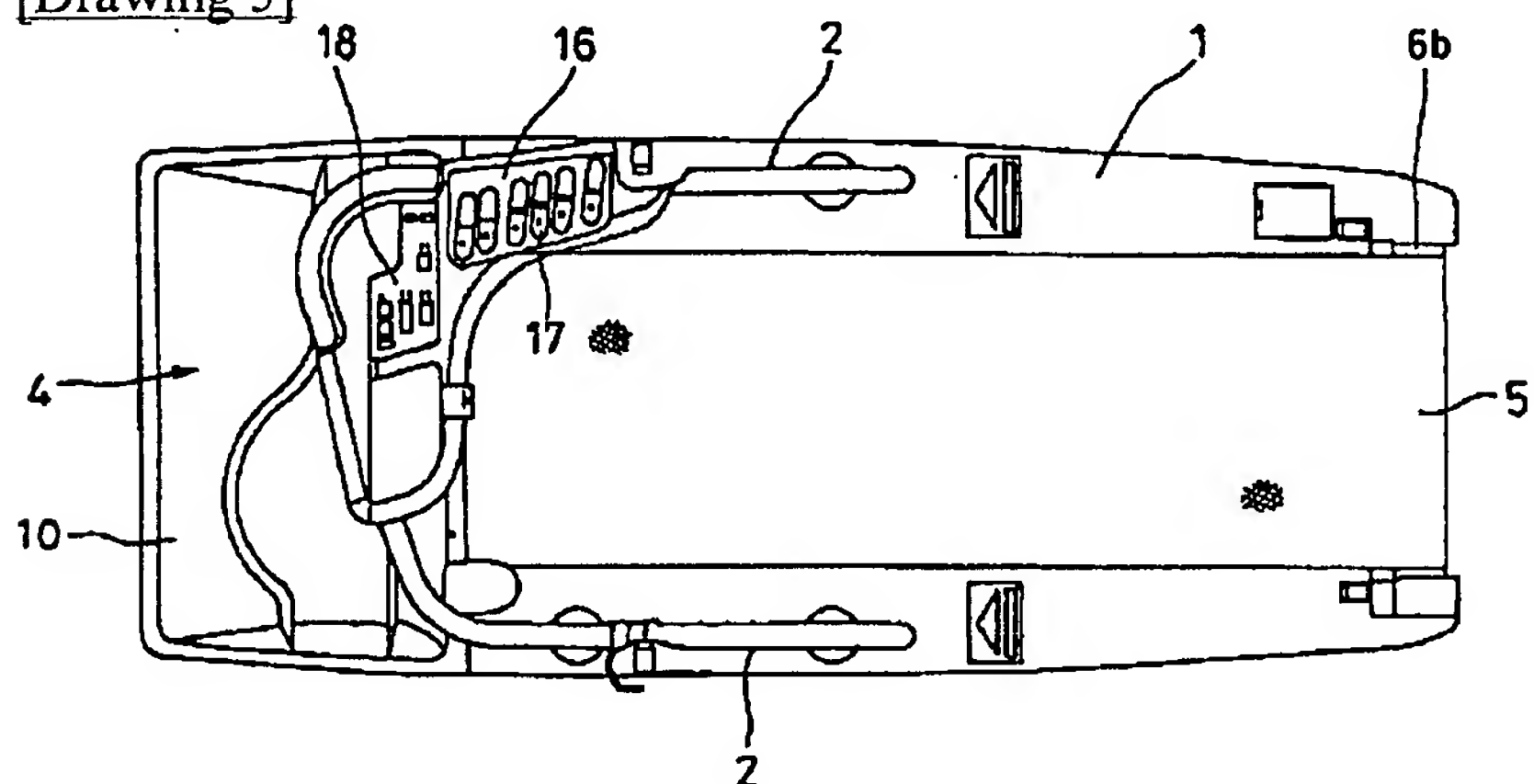
[Drawing 3]



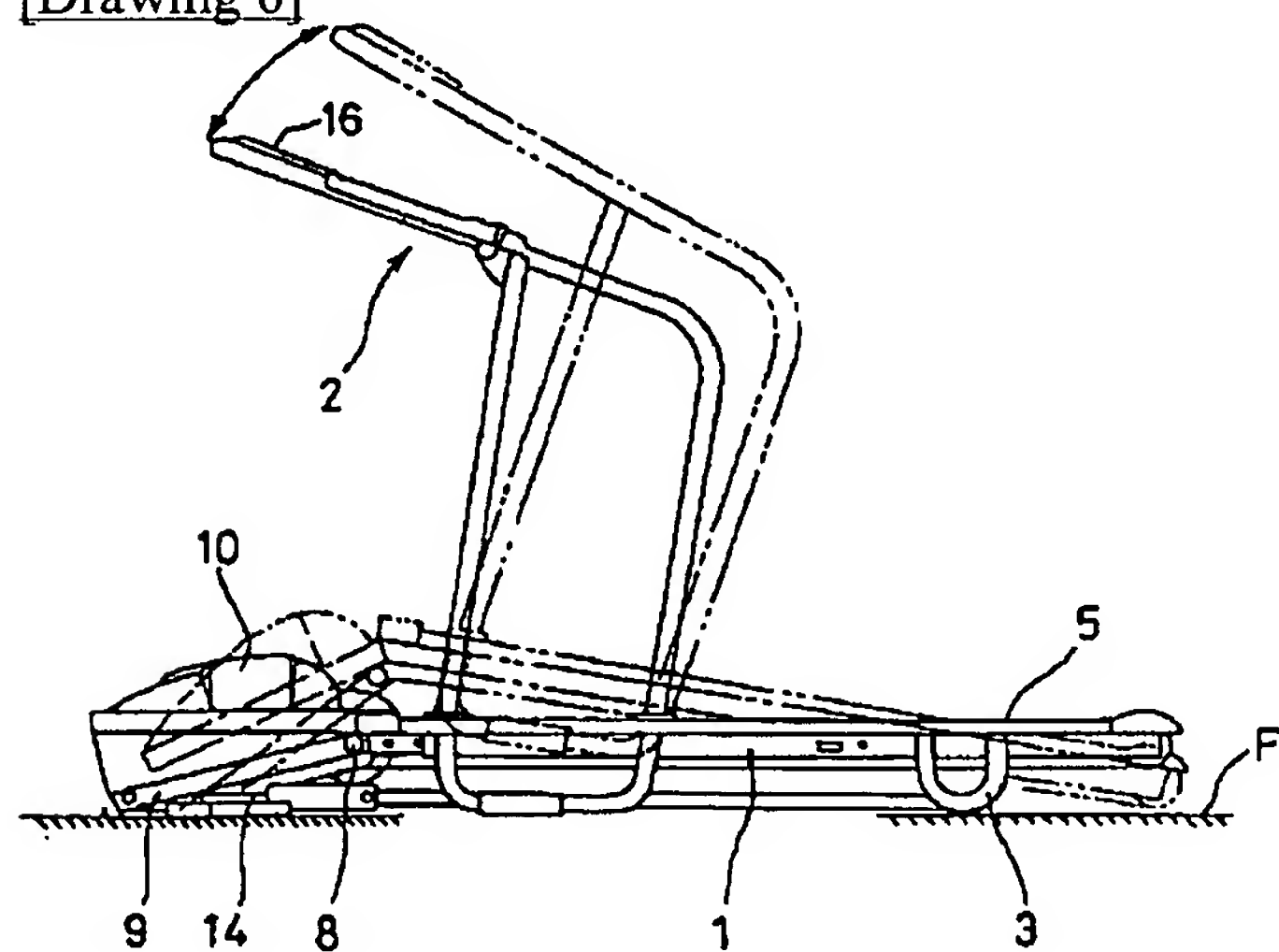
[Drawing 4]



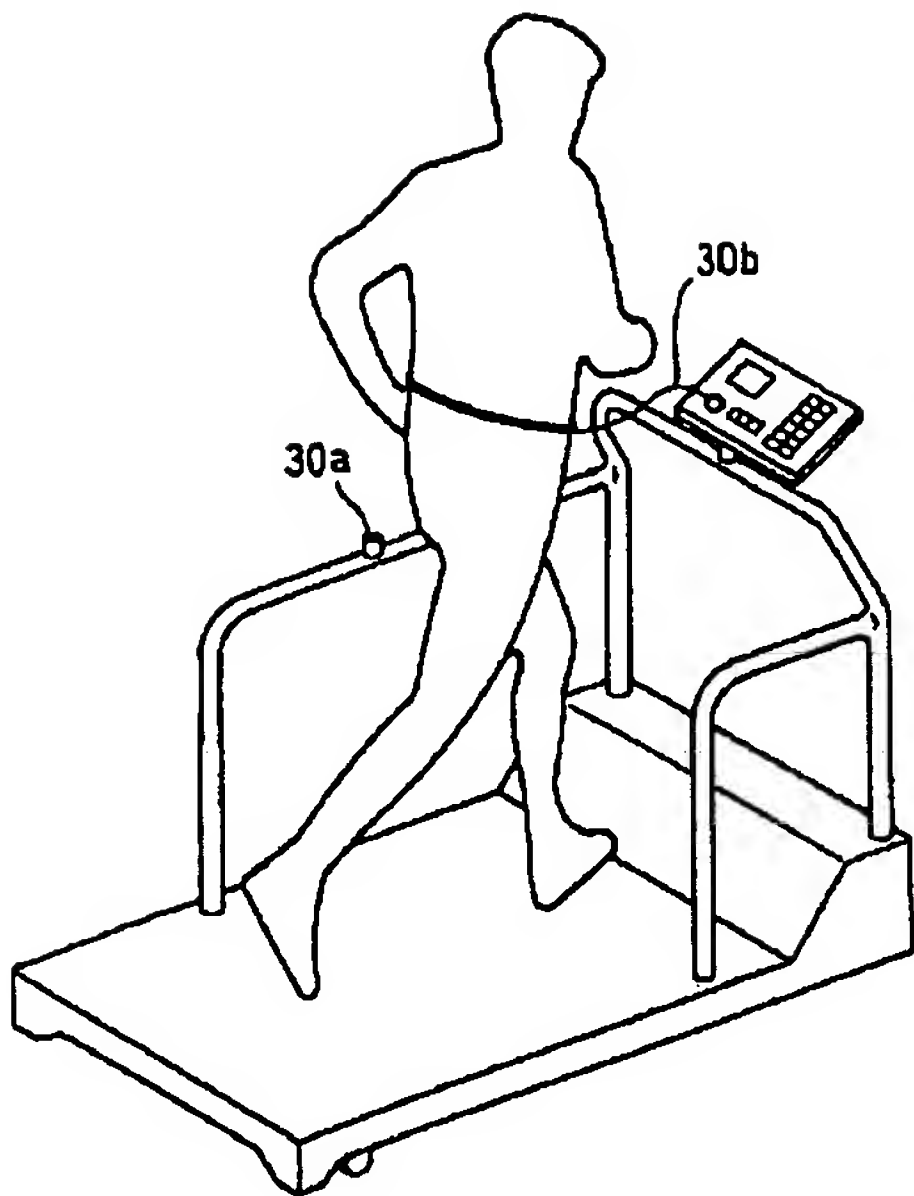
[Drawing 5]



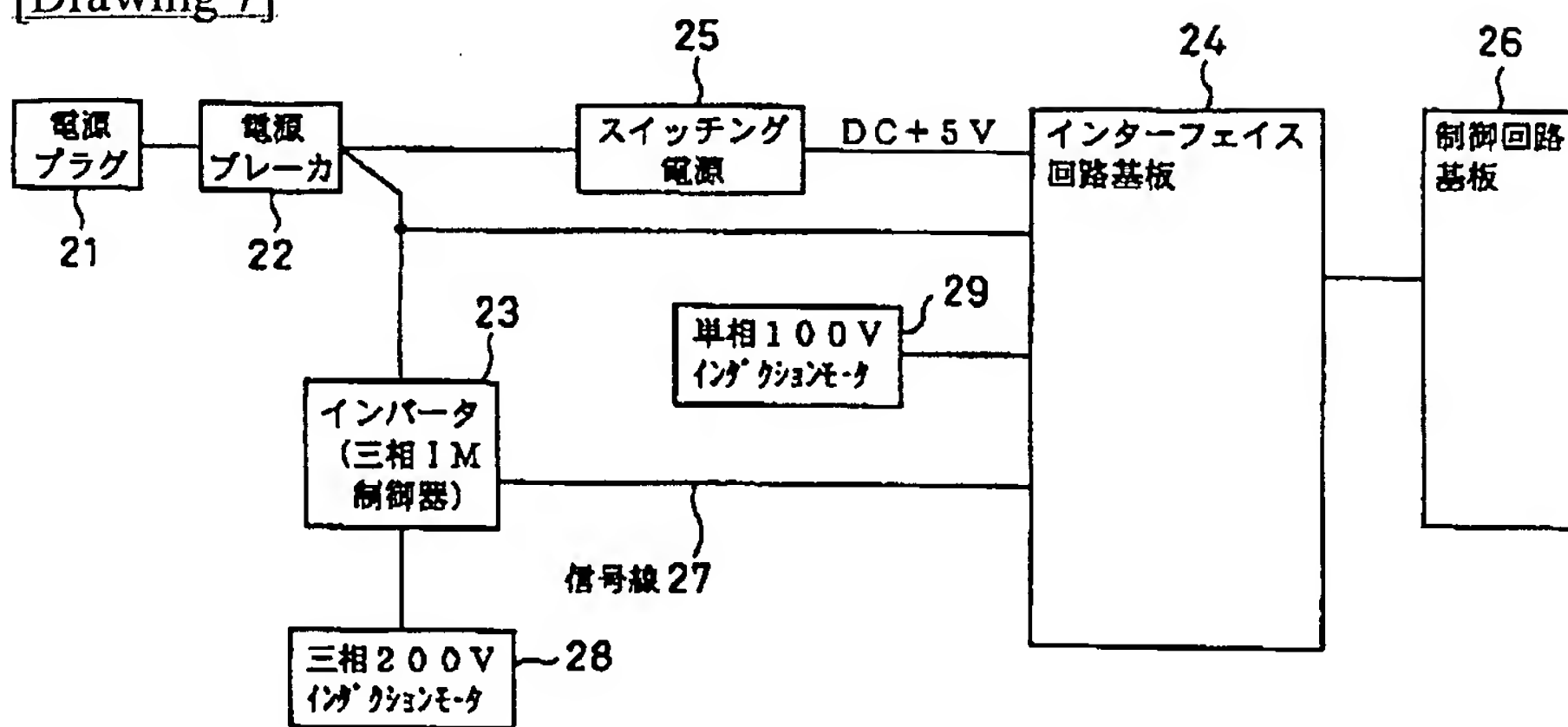
[Drawing 6]



[Drawing 8]



[Drawing 7]



[Translation done.]